National Aeronautics and Space Administration

Converging to Real Precipitation over Ocean and Land: Analysis using TRMM and GPM Products

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Introduction/Motivation

- The highest uncertainty in quantification of precipitation has been in high latitudes. This impacts global water and energy budget calculations and understanding of the hydrologic changes in high latitudes as climate warms.
- Insufficient sensitivity of sensors to capture precipitation signals, poor understanding of precipitation microphysics, unknown surface emissivities, sparse and unreliable ground observations for training and evaluation, difficulties to account for orographic precipitation enhancement, and uncertainties in determining precipitation phase are among some retrieval challenges.
- Rainfall is not the dominant type of precipitation poleward of ~50 deg latitude and traditionally we have had low skill in retrieving snowfall or light rain, the dominant types of precipitation in high latitudes
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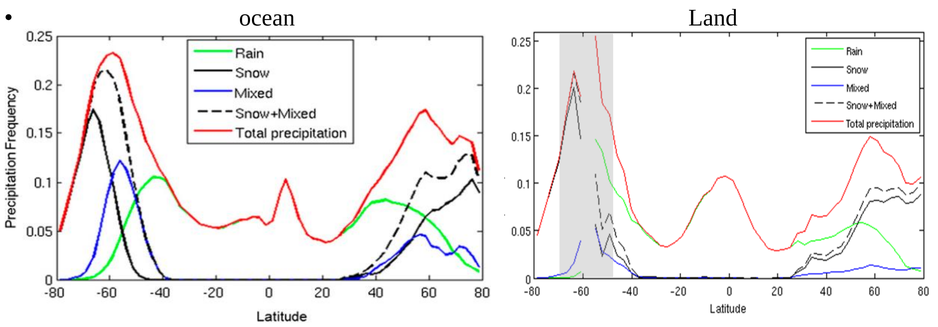
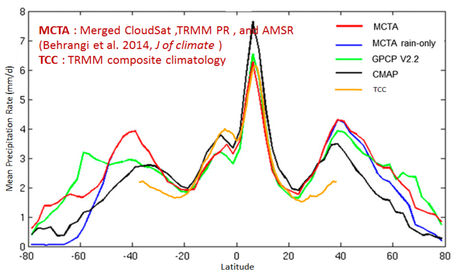


Zonal distribution of precipitation phase frequencies based on CloudSat footprint observations for 2007-2009.

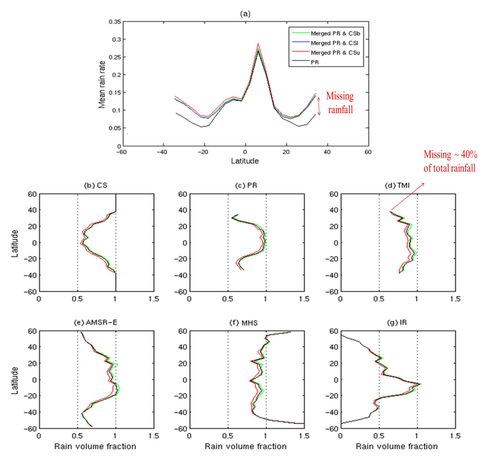
- It is important to assess to what extent GPM products have been effective in reducing precipitation uncertainties observed during TRMM era.

Review: TRMM products

1. Over ocean

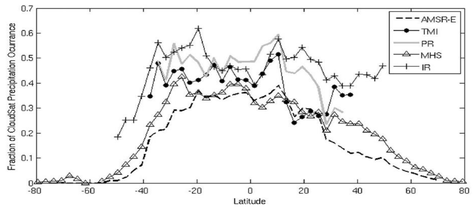


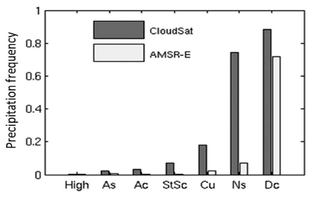
- In the tropics, GPCP, MCTA, and TCC agree quite well
- The Southern Ocean (south of 40°S) has the largest discrepancies.
- At higher latitudes, snow is important and the satellite estimates are less certain
- GPM should provide important new insights in this region.



(a) Zonal mean rain rates of PR and the merged PR-CloudSat rain products. The merged PR-CloudSat products are calculated by merging rain volume distributions of PR and its corresponding CSl, CSb, and CSu rains. (b–g) Zonal fractions of total mean rain rate captured by individual sensors. Note that over the TRMM region the total mean rain rate is obtained from the merged PR-CloudSat rain, while outside the TRMM region CloudSat rain is used as reference.

2. Over land





Acknowledgments

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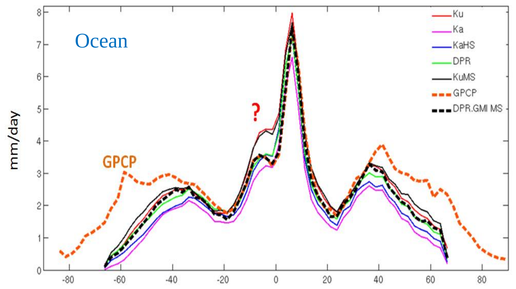
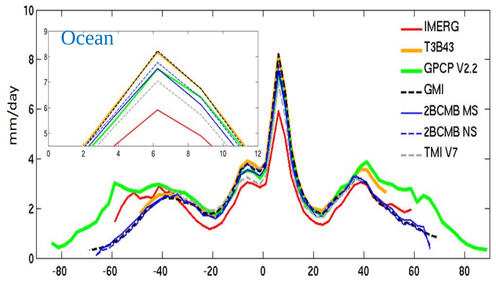
GPM products

DPR products over ocean (201404-201503) ; GPCP and combined(DPR.GPM MS) are used to facilitate comparisons



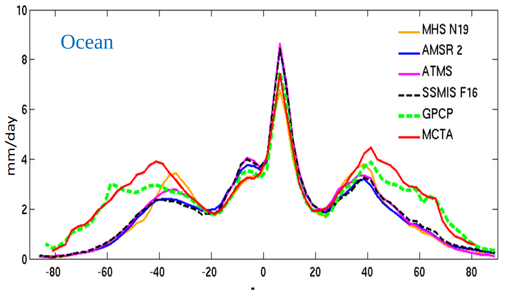
- DPR products commonly underestimate at high latitudes compared to GPCP and MCTA
- Ka and KaHS are low in high latitudes
- Ku/KuMS show higher precipitation rate compared to other DPR products.
- Ku/KuMS show relatively large jump over SH subsidence zone
- DPR and DPR.GMI (CMB) are fairly consistent

GPM products sampling full diurnal cycle (201404-201503) ; GPCP and T3B43 are used for comparison.



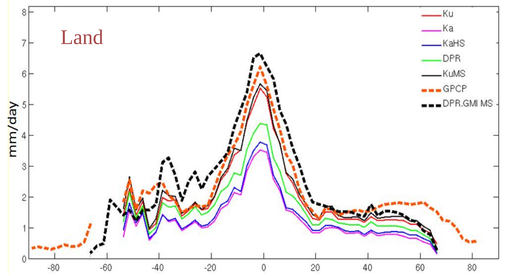
- GPM products commonly underestimate at high latitudes compared to GPCP and MCTA
- Products are fairy consistent over tropics
- IMERG is underestimating over ocean

GPM products with sampling time close to A-train (201404-201503) GPCP and MCTA are used for further comparison



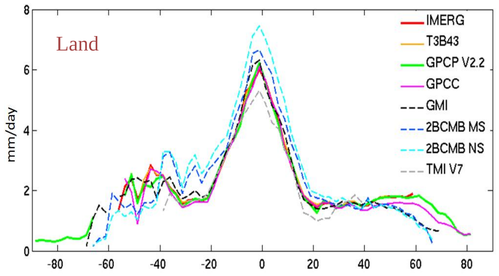
- ATMS and AMSR are outliers in the tropics (over estimating ?) [if true global underestimate : 6% ➔ 11% !]
- MHS shows better match with MCTA over ~ 30-40 S/N but then follows other MW estimates

DPR products over land (201404-201503) ; GPCP and DPR.GPM MS are used for further comparison



- IMERG, TRMM 3B43, and GPCP are almost identical over land (as expected)
- GPCC diverges from GPCP in high latitudes.
- DPR.GMI (CMB) products are much larger than GPCP in the tropics and 20S-40S, but start to underestimate (relative to GPCP/GPCC) poleward of lat. 50deg

GPM products sampling full diurnal cycle (201404-201503) ; GPCP and GPCC are used for comparison



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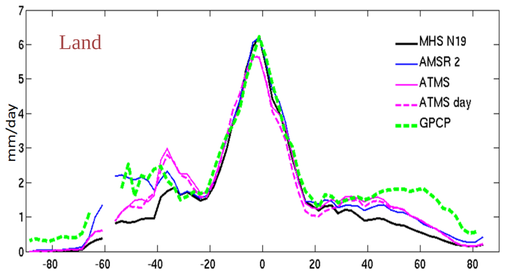
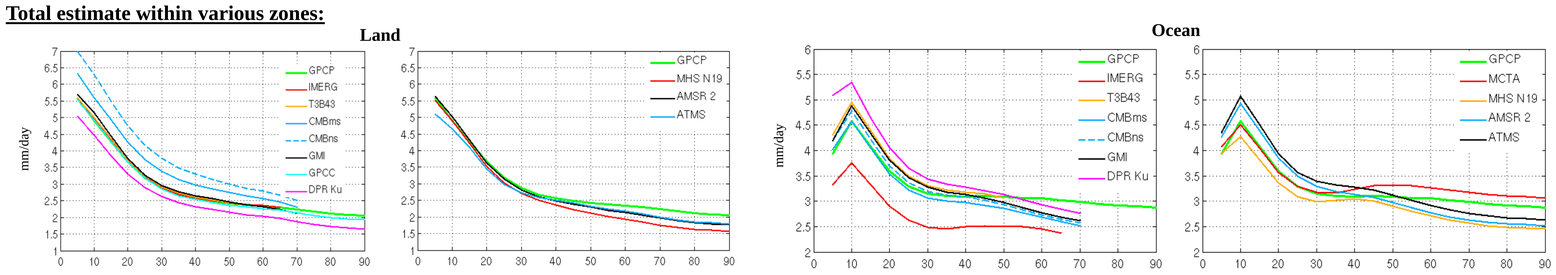
GPM products with sampling time close to A-train (201404-201503) GPCP is used for further comparison



- MHS shows large underestimation poleward of ~ 30 deg S/N compared to GPCP/GPCC

Total estimate within various zones:



Mean precipitation rates calculated between equator and the latitudes shown in the X axis. Plots are provides separately over land and ocean

Comparison conditioned on environmental condition: